NOTES ON THE FLORA OF SITKA, ALASKA.

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INTRODUCTORY REMARKS.

On February 1, 1914, the writer began his duties in connection with the United States Agricultural Experiment Station at Sitka, Alaska. This made necessary a change in thesis subject and at the suggestion of Dr. Pammel, in whose department the major work was taken, the above subject was chosen.

The matter presented is based on collections, observations, and research during a period of two years. The facilities of the Experiment Station have been at the disposal of the writer, but these are quite limited, both as to literature and equipment. The region covered is that within easy walking or motor boat distance of the town of Sitka, but owing to the limited time for the purpose, this region has not been as thoroughly explored as it should be.

The Experiment Station has an herbarium containing several hundred specimens, but it is far from complete, except in the grasses, of which there is a good collection. The specimens from the vicinity of Sitka in said herbarium were collected by Professor C. C. Georgeson, head of the Alaska Experiment Station, and Drs. W. H. Evans and C. V. Piper of the Department of Agriculture at Washington. To these will be added the collections of the writer.

This thesis, as originally planned, was to consist of three parts: part one, to contain notes on the general aspect of the flora with special reference to ecology and economic plants; part two, to be a systematic list of the Pteridophytes and Spermatophytes; while part three was to deal with the fungus flora. Owing to inability to get determinations on some plants, part two is omitted for the present, but will be presented later, as will also notes on groups of parasitic fungi not taken up in detail in part three of the present paper.

In the preparation of these notes, special acknowledgements are due to Dr. L. H. Pammel of Iowa State College, at Ames,

under whose general supervision they have been prepared, to Mr. E. W. Merrill, of Sitka, who has kindly furnished the excellent series of photographs for the plates, many of which were taken expressly for this purpose, and to Dr. J. C. Arthur, of Lafayette, Indiana, who has identified the rust fungi.

THE FLORA IN GENERAL.

TOPOGRAPHY AND CLIMATE.

Sitka is located on the west, or seaward side of Baranoff Island in latitude 57° 3′ North, and longitude 135° 20′ West. It is built partly on gravelly soil, which is an old beach deposit, and partly on some low hills. In the rear of the town is a peat bog or Muskeg, beyond which are some low hills alternating with Muskeg until the base of the mountain is reached, which is less than a mile from the shore line. In most places in the region around Sitka, the distance from the sea to the base of the mountains is much less, as in many places the sea actually beats against the steep slopes of the mountain sides. Except some small areas at the mouths of streams and on the Muskeg the region is all heavily timbered up to about 2,500 feet elevation. The mountains rise to elevations of from 1,800 feet to more than 4,000 feet, with some peaks in the interior of the island about 5,000 feet in height. On some of the higher slopes small glaciers occur.

The shore line is very irregular and the sea in the vicinity is studded with islands. All except the smallest of these islands are forested.

The soil along the shore line consists of coarse gravel mixed with a black material composed mostly of decayed organic matter. Farther in we find some orange-colored soils supposed to be ancient volcanic ash from Mount Edgecombe. This of itself seems almost absolutely sterile to plant growth. This volcanic ash is covered with a layer of muck and peat, varying in thickness. Moss prevails nearly everywhere. At many places, especially on the steeper mountain slopes, there is scarcely anything that could be called soil.

The climate of Sitka is moist and equable. The precipitation averages about 85 inches per annum. Spring and summer are drier than autumn and winter. June is the driest month, with an average rainfall of 3.46 inches, while October is the

wettest with 11.64 inches. The absolute minimum precipitation recorded at Sitka is .45 inches for July and the absolute maximum is 25.52 inches for September.

The average temperature is about 44° F. with only 23° difference between the averages for January and July. The average for the former is between 32° and 33° F., while for the latter month it is between 55° and 56° F. The absolute minimum ever recorded is —4° F., while the maximum is 87° F. There is but little sunshine. There may be weeks at a time when the sun shines every day, and again there may be weeks at a time when the sun is not seen at all. The actual sunshine for the year is probably not more than one-fourth the possible amount. During the growing season, the days are long. Near the summer solstice they are nearly eighteen hours long, the sun dipping only about 9½° below the horizon. Twilights are long.

HISTORICAL.

Sitka having been the Russian capital, as well as the American capital until 1906, it is but natural that more or less collecting of botanical material should have been done in the vicinity. The writer has not had the opportunity to examine into this phase of the subject, but a few facts have been gleaned incidentally. It appears that Henry Mertens of Lütke's expedition and H. G. Bongard[1] in 1832 described a number of species of plants from Sitka, C. B. Trinius describing the grasses. A. Kellogg visited Sitka in 1867.

Since the American occupation a number of collectors, including A. S. Hitchcock, H. C. Cowles and others, have visited Sitka, including the Harriman Alaska Expedition in 1899. Coville, Trelease and Saunders were of this expedition. The specimens in the Experiment Station herbarium were collected by C. V. Piper, W. H. Evans and C. C. Georgeson. A number of other collectors have been in the vicinity but the writer does not, at present, have definite information concerning them.

The following list of type species is incomplete. It is largely gleaned from Professor Piper's work, which includes only such species as are found in the state of Washington.

Agrostis aequivalvis
Alnus sitchensis
Arnica latifolia
Bromus sitchensis
Carex mertensii
Carex sitchensis
Cassiope mertensiana
Cladothamnus pyrolaeflorus
Claytonia asarifolia
Corallorhiza mertensiana
Elymus borealis
Festuca subulata
Juncus mertensiana
Lycopodium sitchense
Picea sitchensis
Poa leptocoma
Pteridium aquilinum pubescens
Pyrus diversifolia
Romanzoffia sitchensis
Salix sitchensis
Saxifraga bongardi
Saxifraga mertensiana
Scorzonella borealis
Sorbus sitchensis
Trisetum cernuum
Tsuga mertensiana
Valeriana sitchensis
Washingtonia purpurea

LIFE ZONES REPRESENTED.

There are three of the life zones represented. These are the Canadian, Hudsonian and Arctic-Alpine. Owing to the moist and equable conditions the limits of these zones are not well defined. While characteristic Canadian species, such as *Cornus Canadensis* and *Sanguisorba latifolia*, occur down to the sea level, we find a liberal admixture of species generally classed as Humid Transition. These, indeed, include some of our commonest species such as *Rubus spectabilis* and *Echinopanax horridum*. On the other hand, some of the characteristic Hudsonian plants are also found near sea level and growing freely in company with the Humid Transition and Canadian species. Among these may be mentioned *Nephrophyllidium crista-galli*. Even some Arctic-Alpine plants grow freely near sea level and among these may be mentioned *Empetrum nigrum*, which is the most abundant and characteristic of all the higher plants growing on the peat bogs or Muskeg.

The characteristics of the Arctic-Alpine zone appear at about 2,500 feet elevation. Plants properly belonging to the Hudsonian zone may reach an elevation of nearly 3,000 feet, while the Canadian species may reach 2,000 feet.

HABITAT GROUPS.

In considering the ecological aspects of the flora one finds that the plants can be segregated into a number of habitat groups. These are quite well defined, corresponding to their physical environment. Mixtures generally occur only in intermediate situations. The typical habitats are five, as follows: Littoral, Forest, Muskeg, Aquatic and Alpine. To these might be added a sixth—the weed habitat. These will now be taken up separately.

LITTORAL FLORA.

(PLATE XVI.)

Included in this group are the species that are found only, or most abundantly, on the sea beaches or their immediate vicinity. Some of these species thrive on rocks where there is scarcely any soil visible. Others occur on gravelly soil. Nearly all the soil found in the immediate vicinity of the sea is composed largely of coarse gravel, while in many places the shore is composed of bowlders or large rocks, in the crevices of which the plants may find some decayed matter and obtain a foothold. The folowing list includes the more typical plants found in this environment:

Ammodenia peploides
Atriplex littorale
Campanula sp.
Cochlearia officinalis
Draba sp.
Elymus mollis
Fritillaria camtschatcensis
Glaux maritima
Ligusticum scoticum
Pedicularis sp.
Plantago maritima
Polygonum paronychia
Polygonum viviparum
Potentilla villosa
Rhinanthus crista-galli
Sisyrinchium sp.
Triglochin sp.
Vicia gigantea

In addition to the group given above there are certain plants that, while not strictly littoral in their habits, are seldom found at any great distance from the sea and are not properly forest, marsh, or aquatic plants. These include several of the grasses, prominent among which are two species of Calamagrostis—C. aleutica and C. langsdorfii. Other plants of this habit are the following:

Achillea borealis
Anaphalis margaritacea
Aster peregrinus
Barbarea vulgaris
Conioselinum gmelini
Epilobium affine
Epilobium angustifolium
Geum macrophyllum
Lepidium sp.
Malus diversifolia
Mimulus langsdorfii
Monarda sp.
Pinus contorta
Potentilla anserina
Ranunculus sp.
Ranunculus tenellus
Rosa nutkana
Salix sitchensis
Sanguisorba latifolia
Sorbus sitchensis
Tissa marina
Veronica americana

FOREST FLORA.

(PLATES XVII TO XXI.)

The forest flora is the most abundant, extensive, conspicuous, and important group growing in southeastern Alaska. The jungle-like growth along the water courses is included under this head.

The forest itself is composed of but few species. The predominant tree, both in size and number, is the Sitka spruce (*Picea sitchensis*). The second in importance is the Western hemlock (*Tsuga heterophylla*). The Alaska or Yellow Cedar (*Chamaecyparis nootkatensis*) is quite abundant and two species of alder (*Alnus Oregana* and *A. sitchensis*) are commonly met with along water courses. The Shore or Lodgepole pine (*Pinus contorta*) is mostly confined to the Muskeg near the shore where it is a shrub rather than a tree, but a few fair sized trees may be found near the borders of the Muskeg. Above 2,500 feet the Black hemlock (*Tsuga mertensiana*) is the only tree found and here it is generally low and bushy. It may occur up to nearly 3,000 feet, although the so-called timber line is about 2,500 feet, this being the limit of the spruce and of typical forest conditions.

Along the banks of streams, near the shore, and on the lower mountain slopes are found jungle growth that is almost impenetrable (Plate XVII). In this growth the Salmonberry (*Rubus spectabilis*) predominates, but such species as Devil's club (*Echinopanax horridum*), wild currant (*Ribes bracteosum*) and species of *Vaccinium* abound.

Traveling in the forest is rendered difficult, not only by the very dense undergrowth, but by the fallen trees. These are often lying across each other. They are covered with a dense growth of moss and many have been lying there for many decades. Often fair sized trees are found growing on these fallen trunks (Plate XX).

One conspicuous feature of the forest is the large amount of moss and lichens hanging from the branches of the trees. This is especially noticeable in the base of the hemlock, where the mosses and lichens find a good foothold on the witches' brooms (Plate XVII) caused by a mistletoe (*Razoumofskya douglasii tsugensis*).

As one ascends the mountain sides the tendency is for the trees to become smaller, the undergrowth to become less dense, and the fallen trunks fewer. Above timber line Arctic conditions prevail.

Often fair sized trees are found growing on rocks where very little soil is evident. In the smaller crevices of rocks are found many species of plants that occur only or mainly in such situations. The following list includes such rock-loving forms as well as those whose typical habit is the sandy or gravelly banks of water courses.

Aconitum delphinifolium
Actea rubra arguta
Adiantum pedatum
Alnus oregona
Alnus sitchensis
Alsine borealis
Alsine crispa
Aquilegia formosa
Arabis lyrata occidentalis
Arabis intermedia
Arabis hirsuta
Arnica latifolia
Aruncus sylvester
Athyrium cyclosorum
Castilleja pallida
Castilleja parviflora
Chamaecyparis nootkatensis
Circæa alpina
Claytonia asarifolia
Claytonia sibirica
Coptis asplenifolia
Corallorhiza mertensiana
Cornus canadensis
Cytherea bulbosa
Echinopanax horridum
Epilobium latifolium
Erysimum chierantioides
Filix fragilis
Heracleum lanatum
Heuchera sp
Kruhsea streptopoides
Linnea americana
Listera convallaroides
Listera cordata
Lycopodium selago
Lysichiton camtschatrense
Menziesia ferruginea
Moneses uniflora
Natalus hastata
Oxyria digyna
Phegopteris dryopteris
Phegopteris polypodioides
Picea sitchensis
Polypodium vulgare
Polystichium braunii
Pteridium aquilinum pubescens
Pyrola secunda
Ribes bracteosum
Ribes laxiflorum
Romanzoffia sitchensis
Rubus pedatus
Rubus parviflorus
Rubus spectabilis
Salix sitchensis
Sambucus callicarpa
Saxifraga sp.
Streptopus amplexifolius
Streptopus roseus
Struthiopteris spicant
Tiarella trifoliata
Tsuga heterophylla
Tsuga mertensiana
Unifolium bifolium kamschaticum
Urtica lyallii
Vaccinium caespitosum
Vaccinium chamissonis
Vaccinium ovalifolium
Vaccinium parvifolium
Vaccinium vitis-idæa
Veratrum viride
Viburnum pauciflorum
Viola glabella
Viola langsdorfii
Washingtonia divaricata
Washingtonia purpurea

MUSKEG FLORA.

(PLATE XXII.)

The term Muskeg, as here used, includes the formations variously called peat bogs, marsh and tundra. The last name, however, should not be used, as the Muskeg is quite different from the true Tundra which surrounds the Arctic Ocean.

This formation consists of peat covered by a layer of moss, mostly Sphagnum. The layer of living and dead, but still undecomposed moss is often a foot in thickness. The depth of the peat varies from a few inches to many feet. On the Muskeg north of the town of Sitka, a hole twelve feet in depth failed to reach the bottom. Scattered about are pools, the surface areas of which vary from a few square feet to several square rods. These pools are generally shallow, but their bottoms are exceedingly soft. In walking over even the firmer portions of the formations one mires a few inches.

Conspicuous features also include the tree growth and small stumps. Except along the edges and the water courses these trees seldom exceed five or six feet in height and are old and decrepit looking. *Pinus contorta* is the most abundant but *Tsuga heterophylla* is common and *Chamaecyparis nootkatensis* is occasional. There is a tendency for the formation to be built up around the base of these trees and especially around the stumps. This gives rise to slight elevations on which such forest species as *Cornus canadensis, Menzeisia ferruginea, Rubus pedatus,* and *Vaccinium vitis-idaea* are generally found.

The most abundant and characteristic plant of the Muskeg other than mosses is the Crowberry (*Empetrum nigrum*). It occurs from sea level to well above timber line. The Ericaceæ are well represented. *Andromeda polifolia, Kalmia glauca, Ledum groenlandicum, Vaccinium Oxycoccus* and *Vaccinium uliginosum* are common at the lower altitudes and *Chamaecystis procumbens* occurs locally. *Rubus chamaemorus* is one of the commonest species as is also the interesting little sundew, *Drosera rotundifolia*. A few species of sedges (*Carex spp.*) are found growing on the Muskeg, but the majority of species prefer the wet soil along the banks of streams or lakes. The cotton grass (*Eriophorum polystachyon*) is very conspicuous when in fruit.

Other plants found in this habitat are as follows:

Coptis trifolia
Dodecatheon sp.
Gentiana douglasiana
Juncus balticus
Juncoides campestre
Lycopodium annotinum
Lycopodium clavatum
Limnorchis dilatata
Limnorchis leucostachys
Parnassia palustris
Pinguicula villosa
Pinguicula vulgaris
Scirpus caespitosus
Tofieldia intermedia
Trientalis arctica

AQUATIC FLORA.

(PLATE XXIII.)

So far as the higher forms of plant life are concerned, this is the smallest division of the flora. Only one species has been noted as occurring in salt water and that is *Zostera marina*. The fresh water forms are a water lily (*Nymphaea polysepala*), two species of Potamogeton (*P. natans* and *P. heterophyllus*), *Callitriche verna*, and *Myriophyllum* sp., *Menyanthes trifolia*. *Comarum palustre*, *Sparganium* sp., and *Carex* spp. represent the semiaquatic species.

ALPINE FLORA.

Under this head are included all species that reach their maximum abundance at or above the ordinary line of timber, which in some cases may be somewhat less than 2,500 feet. Most of these belong to the Arctic-Alpine life zone, but some Hudsonian species are included. Their typical habitat is the Alpine meadows or the crevices of rocks. A very few extend down to sea level and several others are found occasionally between sea level and timber line. The soil at this elevation is largely of a peaty nature but drier and with less moss than the Muskeg. *Empetrum nigrum* is still very abundant and members of the Ericaceæ are among the commonest forms. The following list includes the species of this group so far as observed.

Anemone narcissiflora
Arctoranthis cooleyæ
Artemisia borealis
Campanula sp.
Cassiope mertensiana
Cladothamnus pyrolæflorus
Cryptogramma acrostichoides
Epilobium sp.
Erigeron sp.
Gentiana sp.
Harrimanella stelleriana
Hieracium gracile
Lupinus nootkatensis unalaskensis
Lutkea pectinata
Lycopodium sitchensis
Nephrophyllidium crista-galli
Pedicularis sp.
Phyllodoce glanduliflora
Saxifraga spp.
Sieversia calthifolia
Tsuga mertensiana
Valeriana sitchensis

WEED FLORA.

Of all the weeds that occur in the area covered by this paper, there is one that stands out pre-eminent as causing more trouble than all others combined. That species is the common chickweed, *Alsine media*. The spurry (*Spergula arvensis*) probably would rank second in importance with sorrel (*Rumex acetosella*) third. The following list includes all the species that have as yet become important in this habitat group. It includes several introduced species as well as a few that are included in other lists.

Brassica arvensis
Bursa sp.
Cardamine sp.
Cerastium spp.
Epilobium angustifolium
Epilobium affine
Matricaria matricaroides
Mimulus langsdorfii
Monarda sp.
Montia fontana
Plantago major
Ranunculus repens
Rumex obtusifolius
Rumex occidentalis
Senecio vulgaris
Taraxacum officinale
Veronica americana
Veronica serpyllifolia

In addition to the foregoing, the following have been found, having been introduced with seed, packing, etc. They are, as yet, quite rare and of almost no importance from an economic standpoint. Some may in time become established.

Agrostemma githago
Anthemis cotula
Camelina sativa
Chenopodium album
Polygonum convolvulus
Polygonum pennsylvanicum
Saponaria Vaccaria
Sisymbrium officinale
Solanum nigrum
Sonchus asper
Vicia angustifolia

Mention might also be made of a parasite, *Razoumofskya douglasii tsugensis* (Plate XXIV), which causes much damage to the Western hemlock (*Tsuga heterophylla*). It attacks the branches causing them to enlarge and proliferate. Scarcely a host tree of any size is free from the parasite.

ECONOMIC PLANTS.

The economic plants of Alaska naturally arrange themselves in three groups: 1. Forest trees. 2. Grasses and forage plants. 3. Fruit-bearing plants. These will now be taken up in their order.

FOREST TREES.

Of all the plants native to the coast region of Alaska, the Sitka or Tideland spruce (*Picea sitchensis*) is by far the most

valuable. It dominates the forest from Dixon Entrance to Prince Williams Sound. In the vicinity of Sitka it extends from sea level to 2,500 feet elevation. It attains large size. Logs, six feet in diameter, are sometimes received by the sawmill at Sitka, but the average for the butt logs probably would be about four feet. Three of the larger standing trees near the Experiment Station, as measured by the writer, were 19 feet 2 inches, 18 feet 5 inches, and 16 feet 4 inches, respectively, in circumference about six feet from the base. It furnishes very good saw timber. The wood is light, soft, from fine to moderately coarse-grained. Its color is generally pale brown, often with a fine tinge of red. It is a long-lived species and the larger trees may be several centuries old. According to Sudworth[3] this species may attain a diameter of 12 feet and an age of probably 800 to 850 years. In addition to furnishing nearly all the native lumber used in the region of its occurrence there is a large probability that in course of time it will furnish the basis for a wood pulp industry.

In size and number of individuals the Western hemlock (*Tsuga heterophylla*) is second only to the Sitka spruce. It may dominate the forest locally. A mature tree which was already dead measured 14 feet 4 inches in circumference, but it was not possible to reach high enough to get clear of the buttressed trunk. Close by a typically mature tree measured 10 feet 9 inches in circumference. The wood is rather light, soft, fine-grained, pale yellowish brown with slightest tinge of red. The bark is claimed to contain a larger percentage of tannin than that of the Eastern hemlock (*Tsuga canadensis*). It is our most shade-enduring tree and the young plants may be found growing in the moss covering the earth, old trunks, rocks, etc.

Mountain or Black hemlock (*Tsuga mertensiana*) has comparatively little value. It is really an Alpine tree and reaches its greatest number of individuals at or above the limit reached by the other conifers. Above 2,500 feet, it is the only tree found and here it is usually low and sprawling. Well grown trees of moderate size occur in the forests, but the species becomes rare as one approaches sea level.

The third forest tree in point of importance is *Chamaecyparis nootkatensis,* locally called Yellow cedar, or simply cedar. It

occurs from sea level up to above 2,000 feet. It is not so large as the Sitka spruce or Western hemlock, the largest trees observed by the writer being somewhat less than two feet in diameter. The wood is sulphur-yellow in color, very fine-grained, and comparatively heavy for its class. It is remarkably durable, works easily, and is valuable for interior finish.

Pinus contorta occurs mainly on the Muskeg where it is a stunted shrub. Well grown trees of moderate size occur in favorable locations, but they are infrequent. The wood is hard and resinous.

Red alder (*Alnus oregona*) is largely confined to the banks of water courses, where it may reach a diameter of one foot or more. The wood is pale reddish brown, light, and fine-grained. It is sought locally for fuel.

The Sitka alder (*Alnus sitchensis*) has a wider range of habitat than the Red alder, but does not grow so large.

GRASSES AND FORAGE PLANTS.

A large number of grasses are native to the region but there are three species that are outstanding from an economic point of view. These species are the Beach rye (*Elymus mollis*) and two species of Calamagrostis (*C. aleutica* and *C. langsdorfii*). The first is rather large and coarse but is claimed to make fine feed and silage. It occurs on the beaches and tide flats. The species of Calamagrostis attain a height of from three to six feet and are often called Alaska redtop.

Sedges are not generally so palatable or nutritious as grasses but may be used for feeding stock. Sedges are especially abundant on the borders of lakes (Plate XXIII).

Only one native legume is abundant enough to be of any value whatever as a forage plant. That one is *Vicia gigantea*. It occurs only near the sea.

FRUIT-BEARING PLANTS.

The majority of the fruit-bearing plants of Alaska belong to three genera, Ribes, Rubus, and Vaccinium. Several other groups are represented by one or two species.

Of the five species of Ribes native to Alaska, only two are found in the vicinity of Sitka. These are *R. bracteosum* and *R. laxiflorum*. *Ribes bracteosum* (Plate XXV) is very abundant and one of the most valuable of the native fruits. The bush

has a tendency to be straggling, but the growth is very stout. The diameter of a season's growth often equals one-half inch. The racemes are long but the berries are rather scattered. In size it compares quite favorably with the garden black currant (*Ribes nigrum*) and has that same aroma, but to a more marked degree. The fruit is black, covered with a dense white bloom. All parts of the plants contain glands. Under favorable conditions it is very vigorous and the writer has found racemes 12¼ inches in length, while the leaves may reach an extreme length and width of about eight inches, a leaf of this size having been measured.

The fruit of the wild plant is utilized to a considerable extent. This species is quite promising for use in plant breeding. Crosses with *Ribes nigrum* show a vigorous growth the first year, with no appreciable difference between reciprocal crosses.

Ribes laxiflorum is a much more slender plant than *R. bracteosum* with a tendency for the canes to become prostrate and take root. It has a fetid odor while the taste of the fruit is rather sweetish and insipid. The clusters and berries are about the same size as that of the common garden currant (*Ribes rubrum*), but the fruit is black with whitish bloom and raised glands. It is of little value.

Of seven species of Rubus known to occur in Alaska five are found in the vicinity of Sitka. These will be taken up in order of their importance.

The Salmonberry (*Rubus spectabilis*) (Plate XXVI) forms dense jungles near the sea, along water courses, and in open forests. The canes are perennial, often attaining a diameter of one inch or more and a height of ten to twelve feet. Canes one inch in diameter often show five or six annual rings. Flowers are rose pink and come out very early. The fruit begins to ripen by the middle of June and continues until August, being at its height about July 1st. It is twice the size of ordinary raspberries, and consists of rather large, soft drupelets. The color varies from lemon yellow to dark red. It can be had in large quantities and is utilized to some extent. The flavor is different from that of any other berry. Crosses with the red raspberry (*R. strigosus*) have proven almost entirely sterile, as the pistils and stamens do not seem to develop properly.

The Thimbleberry (*Rubus parviflorus*) is only locally common. It is in cultivation for its large white flowers. The canes are imperfectly perennial, but are seldom more than four to five feet high. The fruit is depressed hemispheric, composed of numerous drupelets, red when ripe and of fair quality.

Rubus Chamaemorus, the Cloudberry, known among the Russians as Maruski, is common all over the Muskeg. It is herbaceous with creeping rootstock and erect branches. Each branch has one or two leaves and often a white flower. The fruit is the size of a large raspberry and consists of few but large drupelets which are amber to red when ripe. The natives are very fond of it and often gather it before it has thoroughly ripened. The quality is quite good.

Rubus stellatus resembles *R. chamaemorus* in habit, but prefers better drained locations and is not so abundant. The flower is pink. The red fruits are of good quality.

Rubus pedatus is a delicate creeping vine with five-foliate leaves found in abundance in forest and brushland. The fruit consists of from one to six rather large, distinct, red drupelets. While the quality is fair, it has but little value.

The strawberry (*Fragaria chiloensis*) though abundant in many places in the coast region of Alaska seems to occur around Sitka only as an escape from former cultivation. The fruit is quite large for a wild berry, and of excellent flavor.

The Crab apple (*Malus diversifolia*) (Plate XXVII) is a shrub or small tree which bears round to oblong fruit varying in size from that of a pea to three-fourths of an inch in length. In quality it is pleasantly, though rather strongly acid, without any trace of astringency. The fruit is used for making jelly and it also has value for the plant breeder.

The Vacciniaceæ are represented by not less than seven species, every one of which has some value.

Vaccinium ovalifolium, the earliest species to ripen, is very abundant and produces a fruit which averages about three-eighths of an inch in diameter, dark blue, with bloom and of good quality. It begins to ripen in June and continues through July. It is much used, especially for pies.

Vaccinium parvifolium (Plate XXVIII), the Huckleberry, is also very abundant, and reaches its maximum development

in the dense shade near the base of the mountains. It is of a clear, bright, almost transparent red and of about the same size as the Early blueberry, although occasionally bushes bear much large fruits and the writer noted one the past season where the berries averaged better than one-half inch in diameter. It is of good quality and much used. It ripens in August and September.

Vaccinium chamissonis (Plate XXIX) is another Highbush blueberry that is abundant. It bears the largest fruit of any member of the genus, but the quality is not equal to that of the other species and many of the fruits are wormy; hence, it is not used to any great extent. The fruit is round to pyriform, purplish black, with scarcely any to very dense bloom. Berries five-eighths of an inch in diameter are sometimes found. The forms included under this head may form more than one species. The pyriform, black, bloomless fruit is quite distinct from the round to slightly depressed fruit with heavy bloom, but intermediate forms occur.

Vaccinium uliginosum is a low growing species common on the Muskeg. The blue berries are somewhat oblong in shape and ripen late. It is often gathered for use.

Vaccinium caespitosum (Plate XXX), is another low growing form and extends from sea level to above timber line. The fruit is somewhat smaller than that of the Highbush blueberries, but it excels them all in quality. While fairly common it is not abundant enough to be gathered economically.

Vaccinium vitis-idaea (Plate XXXI, figure 1), the Mountain cranberry, is our most valuable species of the group. It is dark red and is borne in small clusters at the end of the branches. It is an evergreen species with creeping stem and semi-erect branches. While the fruit is rather small it occurs in abundance and is used to a greater extent than any other native fruit. It is considered superior in quality to the cranberry of the States (*Vaccinium macrocarpon*) and was formerly shipped from Sitka in considerable quantities, but, of late years the native women have found other lines of work more profitable and the export of these berries has dwindled to a very small amount. It is often kept for months in a fresh state in cold water.

Vaccinium oxycoccus (Plate XXXI, figure 2), the Swamp cranberry, is a congener of the cranberry grown in the States, and is of about the same quality, but smaller and variable in size. The vine is very delicate and often almost hidden in the moss of the Muskeg. It is quite common and used to a limited extent.

The crowberry *Empetrum nigrum* is abundant from sea level to Alpine heights, but is not used as human food. It is important as a food for wild fowl such as grouse and ptarmigan.

The Highbush cranberry *Viburnum pauciflorum*, occurs rather sparingly. The brilliant red fruit is of rather better quality than that of *V. Opulus*. It is not of much value as a fruit, but makes a nice ornamental shrub.

The Pigeon-berry *Cornus canadensis*, is an important food for birds, but is used by people only as accidental mixture with cranberries.

Several other fruit bearing plants are known from Alaska, but have not been observed in the vicinity of Sitka.

DESCRIPTION OF PLATES

Plates are all from photographs by E. W. Merrill.

PLATE XVI.

Scene on a small island near Sitka. Near the rock just below the center may be seen some Blue bells (*Campanula* sp.). The white-flowered plant with finely divided leaves is *Achillea borealis;* the one with ternately decompound leaves is *Conioselinum gmelini;* the fern is *Polypodium vulgare;* the grass is *Hordeum boreale,* while the species that is so dominant at the top is Fireweed (*Epilobium angustifolium*). Some leaves of a native Currant (*Ribes bractcosum*) may be seen near the center.

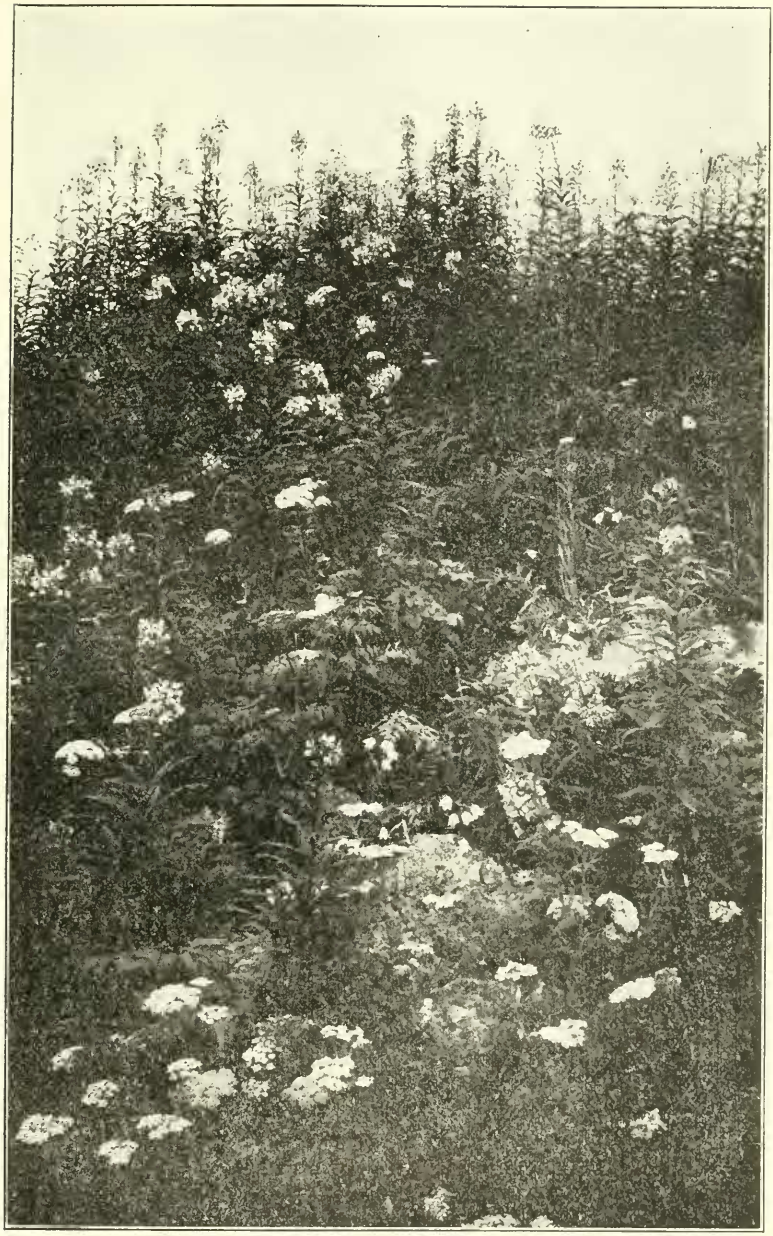

PLATE XVII.

View along a stream showing jungle-like growth along banks. This growth is composed mostly of Salmonberry (*Rubus spectabilis*). The large-leaved shrub is Devil's Club (*Echinopanax horridum*). Mixed in are Vacciniums and Currant (*Ribes bracteosum*), but these do not show in the plate. Note the Witches' brooms on the hemlock (*Tsuga heterophylla*), leaning out over the stream, also the moss and lichens hanging from the branches of this and the spruce just back of it. A young plant of Alder (*Alnus* sp.) appears in the lower left, while a plant of *Kruhsia streptopoides* is seen at the lower right corner.

PLATE XVIII.

Scene at 800 feet elevation showing dense growth of Vacciniums in the foreground. The two trees in the center (one of which is dead), are Hemlock (*Tsuga heterophylla*). Spruce (*Picea sitchensis*) may be seen in the background.

PLATE XIX.

Heavy timber at 800 feet elevation. The large trees in the foreground are Sitka spruce (*Picea sitchensis*). In the left background are Western hemlock (*Tsuga heterophylla*). The large-leaved plant is Skunk cabbage (*Lysichiton camtschatcense*). The shrubs are species of Vaccinium. *Cornus canadensis* may be seen at the base of the large tree in the foreground, and immediately to the left is a plant of a species of Streptopus.

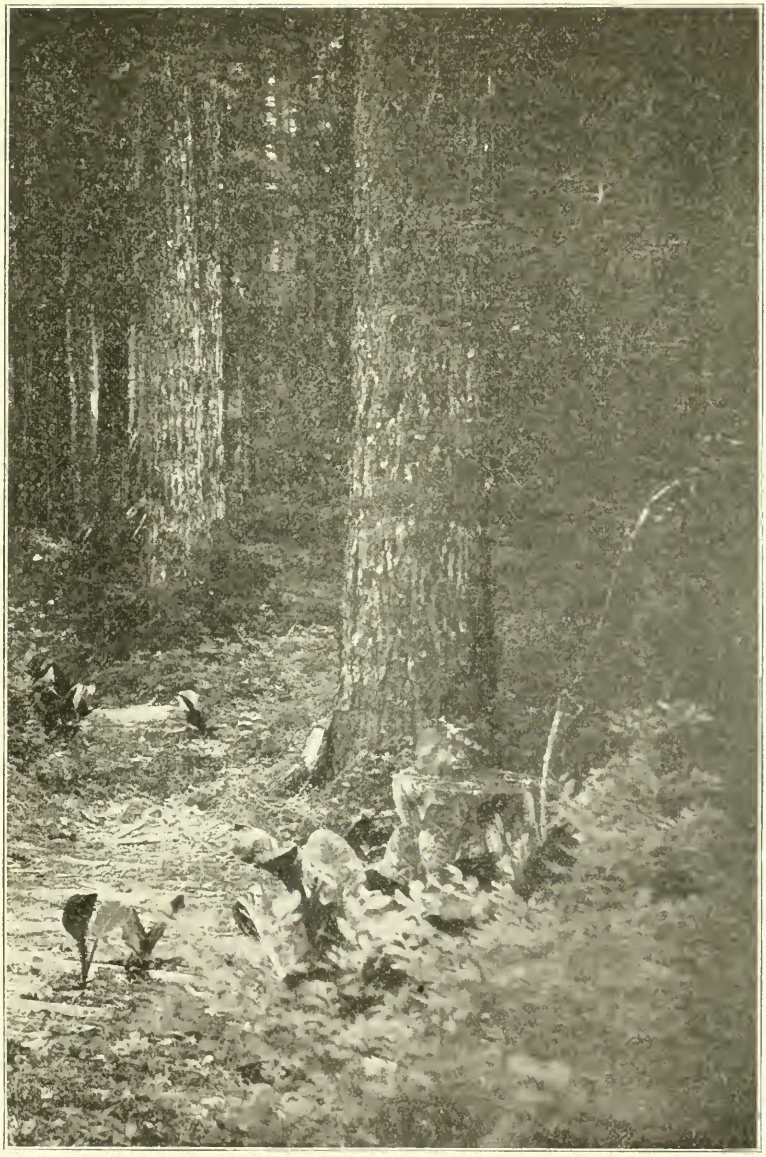

PLATE XX

An old spruce log covered with a heavy growth of moss and with trees of hemlock (Tsuga heterophylla) forty years old growing on top. The shrubs growing on the log are the Red huckleberry (Vaccinium parvifolium). Note also the ferns (Aspidium cyclosorum) and the Devil's Club (Echinopanax horridum).

PLATE XXI.

An open formation at 1800 feet elevation. The most prominent species on the Muskeg here is Cotton grass (*Eriophorum polystachyon*). A dying cedar (*Chamaecyparis nootkatensis*) appears on the extreme right and other cedars, spruce, and hemlock are seen to be growing in association.

PLATE XXII.

View of Muskeg north of Sitka. Note the water holes and stunted trees. These trees are mostly Pine (*Pinus contorta*), but a few Hemlock (*Tsuga heterophylla*) are visible. The trailing bushes to the left of the central water hole are *Vaccinium uliginosum*. Clumps of Sedge (*Carex* spp.) and leaves of Cloudberry (*Rubus chamaemorus*) are also in evidence.

PLATE XXIII.

Scene on Swan Lake, north of Sitka. Note the Water lilies (*Nymphea polysepala*) to the left of which Potamogetons may be seen with *Menyanthes trifoliata* at extreme left. On opposite shore is a dense growth of Carex. The nest containing two eggs is that of the Red-Throated loon and is built on a floating mass of vegetation.

PLATE XXIV.

A branch of Western hemlock (*Tsuga heterophylla*) showing a severe infection of *Razoumofskya douglasii tsugensis*. This causes the branch to proliferate and form a Witches' broom.

PLATE XXV.

A branch of Currant (*Ribes bracteosum*), showing typical fruiting habit.

PLATE XXVI.

Fruit and fruiting habit of Salmonberry (*Rubus spectabilis*)

PLATE XXVII.

A branch showing fruit of native Crab apple (*Malus diversifolia*).

PLATE XXVIII.

Branches of Huckleberry (*Vaccinium parvifolium*)

PLATE XXIX.

Branches of the Late blueberry (*Vaccinium chamissonis*).

PLATE XXX.

A Low bush blueberry (*Vaccinium cæspitosum*).

PLATE XXXI.

Fig. 1.—The Mountain cranberry (*Vaccinium vitis-idaea*).
Fig. 2.—The Swamp cranberry (*Vaccinium Oxycoccus*).

THE FUNGUS FLORA.

Work on the fungus flora has been largely confined to parasitic forms or those appearing on particular hosts shortly after the death of the plant. Of the groups to which little attention has been paid, the Agaricaceæ should receive mention on account of their abundance in both species and individuals. Several species are gathered and used as food.

During the past two years, during which time the writer has been at Sitka, a collection of nearly 300 numbers of fungi has been made. In this collection imperfect forms and Pyrenomycetes greatly predominate. While many of the species are known, there are so many unidentified forms in most orders and families that it is deemed advisable, at this time, to consider only two groups—the Erysiphaceæ and the Uredinales—leaving the other groups until further identifications may be made, when it is hoped to present the same in considerable detail.

ERYSIPHACEÆ.

The Erysiphaceæ, commonly called Powdery mildews, are not so abundant as they are in many other localities. They were collected on only about fifteen different host plants, whereas the writer found them to occur on at least 186 hosts in the State of Iowa,[4] and Salmon[5] enumerates a host index of much more than 1,200 species.

In this list, and also the one that follows, on the Uredinales, the numbers in parentheses which follow the name of the host plant refer to the collection number.

Sphaerotheca humuli (DC.) Burr. Hop Mildew.

On *Epilobium affine* Bong. (72). On this host the mildew seems very destructive at times, and is quite widespread.

On *Fragaria chiloensis* (L.) Duchsne. What appears to be the conidial stage of this mildew is troublesome in the greenhouse on young plants which are hybrids of this species.

On *Fragaria platypetala* Rydb. This species also is affected in the greenhouse.

On *Ribes aureum* Pursh. (248). Only one slight infection observed on this cultivated species.

On *Ribes bracteosum* Dougl. (73 and 188). Not widespread but sometimes quite severe on this native currant. Some

young hybrid seedlings of this species and the garden black currant (*R. nigrum*) became severely infected during the fall of 1915. It has not been observed on *R. nigrum*.

On *Ribes rubrum* L. (190). Does not seem to be severe on this host and there seems to be a great deal of difference in the resistance of the different varieties. Of the red currants grown at the Station, Perfection seems to be most susceptible.

On *Rubus spectabilis* Pursh. (187). Infection seems to be severe, but local.

Spaerotheca mors-uvae (Schw.) B. & C. Gooseberry mildew. this can be distinguished from the preceding by its dark, dense, felted mycelium. It is abundant on the fruits while *S. humuli* is mostly confined to the leaves, petioles and young stems.

On *Ribes lacustre* (Pers.) Poir. (74). During 1914 this species was very abundant and destructive, being found on berries, leaves and stems. Scarcely a fruit escaped its ravages. During 1915 it did but little damage. Two thorough sprayings with Bordeaux mixture helped to keep it in check. The host is native to Alaska, but does not occur near Sitka.

On *Ribes uva-crispa* L. (75). Very abundant and destructive on some varieties of the English gooseberry, while other varieties (e. g. Whitesmith) seem nearly immune.

Sphaerotheca pannosa (Wallr.) Lev. Rose mildew.

On *Rosa sp.* (180). This mildew is common and troublesome on many of the tea roses grown indoors.

Erysiphe graminis DC. Grass mildew. This species is not abundant, but the conidial stage occurs sparingly on a few grasses.

On *Agrostis exarata* Trin. (191).

Erysiphe sp. The conidial stage of a mildew has been collected on *Achillea borealis* Bong., and on *Ranunculus sp.* The former may be *E. cichoraccarum*, DC., while the latter probably is *E. polygoni* DC.

Microsphaera alni (Wallr.) Wint. Alder mildew. This species does not seem to be common.

On *Alnus sitchensis* (Regel) Sarg. (213).

Uncinula salicis (DC.) Wint. The Willow mildew was collected at Skagway, by the writer, July 13, 1915, on *Populus trichocarpa* T. & G. (192), but has not been observed at Sitka.

UREDINALES.

This interesting group of obligate parasites is quite well represented, and most of the species are of more or less economic importance. Following the general usage the Roman numerals are used in the following notes to designate the three main stages in the life cycle of the rust. These are as follows: I—Aecia; II—uredinia; III—telia. Small bodies known as pycnia are generally found in association with the æcia and sometimes in association with the other forms. This stage is designated by O.

All the species here enumerated have been determined by Dr. J. C. Arthur of Lafayette, Indiana, who is recognized as one of the leading authorities on the group.

MELAMPSORACEÆ.

Melampsora biglowii Thum.

II—On *Salix sitchensis* Sanson. (193). The writer collected this at Skagway, July 13, 1915. It has not been observed at Sitka and probably does not occur, as the alternate host is Larix and this tree is not found in the vicinity.

Pucciniastrum myrtilli (Schum.) Arth.

II, III—On *Vaccinium caespitosum* Michx. (69).

II, III—On *Vaccinium ovalifolium* J. E. Smith. (196).

This rust seems to be rather infrequent.

Pucciniastrum pustulatum (Pers.) Diet.

II, III—On *Epilobium affine* Bong. (173), (271).

Common and quite destructive.

Melampsoropsis ledicola (Peck.) Arth.

II, III—On *Ledum groenlandicum* Oeder. (68).

Common, but only moderately destructive.

Melampsoropsis pyrolae (DC.) Arth.

II, III—On *Moneses uniflora* (L.) A. Gray. (70).

Common and sometimes locally destructive.

Hyalosora aspidiotis (Peck) Magn.

II, III—On *Phegopteris dryopteris* (L.) Fee. (67).

This is quite common.

Peridermium coloradense (Diet.) Arth.

I—On *Picea sitchensis* (Bong.) T. & M. (57).

This is very common around open places, but does not seem to be found in the denser forest. It is sometimes quite destructive to small trees, as it causes a loss of a large portion of the leaves. It is included under the family Melampsoraceæ as probably it is genetically connected with one of the foregoing species.

PUCCINIACEÆ.

Phragmidium occidentale Arth.

On *Rubus parviflorus* Nutt. (50 and 51).

On the Station grounds this rust is abundant enough to be decidedly injurious to the host.

Phragmidium rosae-acicularis Liro.

On *Rosa hemisphaerica* Herrm. (19). This host seems somewhat more susceptible than *R. rugosa* and its hybrids.

On *Rosa nutkana* Presl. (52 and 53). This is our native rose. It seems very susceptible.

On *Rosa rugosa* (267) and hybrids (195).

Xenodochus minor Arth.

On *Sanguisorba latifolia* (Hook.) Coville. (54, 113 and 202)

This rust is very common. All the forms occur. Dr. Arthur, in a letter to the writer, says concerning some material belonging to this species, which was sent to him September, 1915, "Your material gives the first collection of æcia belonging to *Xenodochus minor,* which has come to hand."

Gymnosporangium sorbi (Arth.) Kern.

O, I—On *Pyrus* (*Malus*) *diversifolia* Bong. (56).

This rust is common on the native crab apple and is sometimes injurious locally.

O, I—On *Sorbus sitchensis* Roem. (55). During 1914, this species was badly affected, but in 1915 it had suffered to such an extent from attacks of Entomosporium that but few leaves were left to be attacked by the rust.

Uromyces caryophyllinus (Schrank.) Wint.

II, III—On *Dianthus caryophyllus* L. (186). This rust developed rather sparingly on the common greenhouse carnation.

Puccinia acuminata Peck.

III—On *Cornus canadensis* L. (58). This rust forms dense, black, circular spots on the under surface of the leaf, 1 to 2 mm. in diameter. Infection is not general, but it is abundant in places.

Puccinia circaea Pers.

On *Circaea alpina* L. (203). Common wherever the host is found.

Puccinia epilobii-tetragoni (DC.) Wint.

I—On *Epilobium affine* Bong. (59). Common on young plants shortly after starting growth in the spring.

Puccinia grossulariae (Schum.) Lagerh. This species is by all odds our most abundant and destructive species of rust. Forms 0 and I occur on species of Ribes while forms II and III infect species of sedges belonging to the genus Carex. Of the fourteen species of Ribes growing on the Experiment station grounds in 1915, exactly one-half were affected. The different species differ very much in the degree of infection, as is noted under the remarks on each.

On *Ribes alpinum* (65). This host suffered a rather moderate infection, in both 1914 and 1915.

On *Ribes bracteosum* Dougl. (60). This species seems to suffer quite severely when exposed to infection from nearby sources of Carex, but plants growing in the forest away from sources of infection are nearly or entirely free.

On *Ribes lacustre* (Pers.) Poir. (61). This seems to be the most susceptible species of all. In 1914, the infection was severe indeed. In 1915, control measures were largely successful.

On *Ribes laxiflorum* Pursh. (63). The writer has observed plants of this species along the edge of the Muskeg where *Carex stygia* was abundant, so badly infected that they lost most of their leaves while a few rods away the infection was moderate to light.

On *Ribes oxycanthoides* L. (66). Varieties of gooseberry derived from the American species show moderate infection while some of its hybrids with the European gooseberry show light infection.

On *Ribes rubrum* L. (64). The common red currant seems to be rather lightly infected.

On *Ribes sanguineum* Pursh. (178). This species was planted on the station grounds in 1914. The first season it was scarcely infected at all, but in 1915 the infection was very severe.

On *Carex macrochaeta* C. A. Meyers. (251).

On *Carex mertensii* Prescott. (250).

On *Carex sitchensis* Prescott. (252). This and the two species above are moderately to rather severely infected.

On *Carex stygia* Fries. (197). This sedge is very abundant all over the Muskeg, and seems always to be heavily infected with the rust. From an economic point of view, it is by far the most important Carex host of the Puccinia under consideration, and from it most of the infection of the Ribes on and near the Experiment Station grounds probably takes place.

Puccinia poarum. Niessl.

II—On *Poa pratensis* L. (166). Not very common.

Puccinia pygmaea Erikss.

II—On *Calamagrostis aleutica,* Bong. (201 and 218). Frequent, but only a small portion of the host plants seem to become infected.

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